ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

DATE: February 1999

BUDGET ACTIVITY: **2 - Applied Research**

PE NUMBER AND TITLE: **0602716A Human Factors Engineering Technology**

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	16577	16473	16392	16270	17274	16657	16924	17746	Continuing	Continuing
AH34 Rural Health Technology	2810	3228	0	0	0	0	0	0	0	5522
AH70 Human Factors Engineering Systems Development	13767	13245	16392	16270	17274	16657	16924	17746	Continuing	Continuing

A. Mission Description and Budget Item Justification: The objectives of this program are, first, to maximize the effectiveness of soldiers in concert with their materiel so that they may survive and prevail on the battlefield. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of soldiers, with particular attention on soldier and equipment interaction. Secondly, this program focuses on the development, field testing, and empirical validation of methods for improving the coordinated functioning of civilian and military emergency medical teams. The work in this latter effort complements related Army programs in soldier performance, training and evaluation methodologies, and will provide direct research benefits to the Army's medical community, including combat casualty care on the battlefield and in other remote areas of operation. The work in this program is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. All work under this PE is part of the Human Systems Tri-Service Reliance panel.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	16723	13369	14193	14396
Appropriated Value	17256	16619		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-533	-146		
b. SBIR / STTR	-110			
c. Omnibus or Other Above Threshold Reductions	-36			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+2199	+1874
Current Budget Submit (FY 2000 / 2001 PB)	16577	16473	16392	16270

Change Summary Explanation: Funding – FY 1999 – Congressional increase for Rural Health Technology (+3250)
FY 2000 (+2199) and FY 2001 (+1286) to support research in cognitive engineering and transition products from the Advanced
and Interactive Displays Federated Lab.

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PROJECT: AH34

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH34 Rural Health Technology	2810	3228	0	0	0	0	0	0	0	5522

Mission Description and Justification: This is a congressionally funded program; not part of the Army's core mission funded program. The Medical Teams program provides for the continued development, field testing, and empirical validation of methods for improving the coordinated functioning of emergency medical teams (both military and civilian). This project, initially supported by Congress in FY96, extends previous Army research on the effective training and evaluation of military aviation crews and systematically applies it to the collection of hospital and pre-hospital personnel who must perform as an effective team during the initial "golden hour" of shock/trauma or acute patient care. Additionally, this project provides both the civilian and military medical communities with a rigorous framework for objectively demonstrating and assessing the "value-added" of selected telemedicine and medical decision management technologies.

FY 1998 Accomplishments:

- 2810 - Completed evaluation of the prototype hospital training and evaluation system at each of the cooperating hospitals.
  - Completed an extended team testbed at Madison Army Medical Center.
  - Completed a test of an advanced intra-team communication system at Madison Army Medical Center and Rhode Island Hospital.

Total 2810

FY 1999 Planned Program:

- 3142 - Complete the evaluation of the MedTeams training and evaluation system at each of the cooperating hospitals selected in Phase I.
  - Conduct an extended team test bed at Madigan Army Medical Center.
  - Conduct a test of an advanced intra-team communication system at Madigan Army Medical Center and Rhode Island Hospital.
  - Develop, in conjunction with University of Maryland Shock Trauma Center, an improved protocol for field-to-hospital communications.
  - Introduce MedTeams research products to civilian and emergency care facilities at selected locations in CONUS.
  - Execute concept development for MedTeams combat casualty care with the cooperation of Army, Navy and Air Force participating hospitals.
- 86 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 3228

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602716A Human Factors Engineering Technology

PROJECT: AH70

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH70 Human Factors Engineering Systems Development	13767	13245	16392	16270	17274	16657	16924	17746	Continuing	Continuing

Mission Description and Justification: This program focuses on maximizing the effectiveness of the soldier in concert with his materiel, in order to survive and prevail on the battlefield. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of soldiers, with particular attention on soldier and equipment interaction. The resulting data are the basis for weapon systems and equipment design standards, guidelines, handbooks and soldier training and manpower requirements to improve equipment operation and maintenance. Application of advancements yields reduced workload, fewer errors, enhanced soldier protection, user acceptance, and allows the soldier to extract the maximum performance from the equipment.

FY 1998 Accomplishments:

- 4787 -Extended collaborative planning tools to logistics planning, preparation and execution at all echelons. Transitioned software-based tools to Combined Arms Support Command (CASCOM).
  - Investigated control and operator sensing strategies and configurations for teleoperated manipulator devices performing military tasks. Developed baseline operator workload models for unmanned ground vehicles. Transitioned data to the Program Manager for Unmanned Ground Vehicles (PM UGV) and U.S. Army Aviation and Missile Command (AMCOM).
  -Published findings on sensor human feedback devices and exoskeleton control devices. Transitioned data and guidelines to Natick RDEC, Soldier Systems Command (SSCOM), and the Infantry School.
  - Accomplished verification and validation of the auditory detection model. Conducted a study to assess the impact of multi-directional auditory displays on crew performance in armored vehicles for TARDEC.
  -Conducted cognitive analysis of command, control, communications, computers and intelligence (C4I) systems and developed models to assess system effects on decision making and the ways soldiers visualize military operations for the Battle Command Battlelab.
- 3987 - Developed unique features and refinements for the human figure performance model (JACK) with emphasis on improving run-time, user interface and fidelity and decreasing the time and cost to use critical features.
  -Completed Improved Performance Research Integration Tool (IMPRINT), Version 3, which incorporates embedded analysis wizard, advanced workload analysis capability, and updated resident databases for use in soldier-system front end analyses.
  -Refined the virtual reality capability for the individual soldier fighting systems in a DIS environment; integrated the sensor suit (which records the movements of humans engaged in strenuous exercise) and a low to medium resolution version of the soldier icon (JACK); initiated collection of baseline data for live and virtual studies. Transitioned data and design guidelines to Simulation, Training and Instrumentation Command (STRICOM).
- 4993 - Developed soldier-system analysis and tradeoff tools and workload models for assessing soldier and unit performance and the life cycle cost implications of choices in concept and system designs.

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FY 1998 Accomplishments: (Continued)

-Provided HFE support to AMC, AMC RDECs, TRADOC activities, battle labs, and other laboratories.
-Developed an integrated set of soldier-information system performance based design standards and demonstrated in Division AWE.

Total 13767

FY 1999 Planned Program:

- 4482 -Enhance existing logistics data analysis capabilities to serve logisticians at appropriate echelons.
- Refine operator workload models for unmanned ground vehicles.
-Investigate the impact of multi-directional auditory displays on helicopter pilot performance. Publish results and provide to the Aviation School and Aviation and Missile Command.
-Develop a human performance measurement strategy to assess new command and control concepts in the distributed interactive simulation (DIS) environment.
- Identify, in terms of soldier performance, how the application of 2-D and 3-D visualization concepts impacts the battle staff's task domain. Identify and quantify which advanced visualization concepts enhance or detract from staff performance and how they support collaborative planning and problem solving by a geographically dispersed staff.
- 3997 -Verify and validate the human figure performance model (Jack), link with physics based model, and begin to incorporate data collected in 3-D.
-Add training requirements analysis capability and enhanced performance degradation modeling to Improved Performance Research Integration Tool (IMPRINT) Version 3.
- Collect performance data using the virtual reality capability for the individual soldier fighting systems in a DIS environment, compare results of live and virtual studies, and update and validate the databases with actual research data. Transition data and guidelines to STRICOM.
- 4649 -Refine soldier system analysis and tradeoff tools and workload models for assessing soldier and unit performance and the life cycle and cost implications in concept and system designs. Enhance human factors engineering field evaluation methods with soldier in the loop operational test data to upgrade existing capabilities to assess new technologies and systems.
-Provide HFE support to AMC, AMC RDECs, TRADOC activities, battle labs, and other laboratories.
- 117 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 13245

FY 2000 Planned Program:

- 4956 - Enhance logistic planning tools to enable warfighting analysis of enemy logistics capabilities and vulnerabilities.
- Develop a baseline model of current unit level vehicle maintenance operations for use in assessing soldier performance and organizational design. Transition methods to the Ordnance Center and School.

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- Conduct studies to investigate the relationship between human sensory capabilities and vehicle control requirements for both on-board and teleoperated systems. Transition data to PM UGV, Aviation and Missile Command, and TARDEC.

FY 2000 Planned Program: (continued)

- Conduct field study to determine the effect of advanced display technologies, e.g. 3-D audio, speech recognition and active noise reduction on dismounted soldier task performance under different levels of physical and mental workload.
- In collaboration with Natick Research Development and Engineering Center (NRDEC) and the Infantry School, define a dismounted soldier baseline day for use as an R&D standard scenario.

•	3593	Refine and validate the command and control human performance measurement study in the DIS environment for use in evaluating system concepts in relationship to individual, collective and teamwork requirements. Transition methods and techniques to the Battle Command Battle Laboratory and the Depth and Simultaneous Attack Battle Laboratory. - Perform soldier focused assessments of various battlefield reasoning and multi-modal display systems to support the commander and staff's ability to use intelligent algorithms to produce end states, generate courses of action and maintain situation awareness related to enemy as well as friendly forces. - Develop a set of predictive models and performance metrics for cognitive re-engineering of the battle command process. A refined process model of command and control planning and execution decision making for integrated battalion through Corps will be developed. Behavior based metrics for assessing commander and staff performance with digitized systems will be evaluated in Army Capstone exercises. - Complete development of a rule-based computer model of the intelligence production system which simulates how the quality of information in military intelligence databases and the soldier's ability to use that information will meet commander and staff military intelligence requirements.
•	5643	- Enhance the human figure performance model to include development of fully scaleable, smooth contoured human body model; fast, dynamic variable thickness clothing model; and high fidelity hand model. - Add the capability to model performance under stress to the Improved Performance Research Integration Tool (IMPRINT) and demonstrate links to advanced distribution simulation. - Collect human performance data and develop kinematics and dynamic mobility models and simulations to support further development of control methodology and algorithms for the virtual reality (VR) capability for the dismounted soldier. Provide guidelines to STRICOM. - Conduct enhanced HFE field evaluations with solider-in-the-loop operational test data to upgrade existing capabilities to assess new technologies and systems. - Provide HFE support to AMC, AMC RDECs, TRADOC Centers, Schools and Battle Laboratories and other laboratories.
	2200	- Leverage Strike Force planning and experimentation to address critical training, leader development and soldier support (TLS) research issues in the cognitive engineering of battle command operations. Facilitate transition of research products from the Advanced & Interactive Displays Fed Lab into the experimental process.
Total	16392	

FY 2001 Planned Program:

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- 5184 - Develop automated measurement tools that enable a common relevant basis for viewing, analyzing and assessing sustainment capability and responding to a wide variety of logistics issues across echelons. Develop an ammunition configuration process simulation for assessing various loads.
  Transition tools and techniques to CASCOM and PM Ammolog.

FY 2001 Planned Program: (continued)

- Develop and evaluate prototype tools and maintenance aids to reduce soldier workload in the conduct of vehicle service tasks. Transition to PM Test, Measurement, and Diagnostic Equipment (TMDE)
- Publish results of previous studies on human sensory capabilities and operator performance. Develop and refine a comprehensive model of human operator performance for both on-board and teleoperated systems.
- Translate research results on the effects of advanced audio display technologies on dismounted soldier tasks performance into design guidelines for use by NRDEC, the Infantry School and Dismounted Battlespace Battle Lab.
- Complete development of the dismounted soldier baseline day for use in evaluating soldier equipment interface and compatibility. Transition to NRDEC and the Infantry School.

- 3858 - Publish technical report on the previously developed command and control performance measurement strategy and apply to system test and evaluation activities.
  - Perform realistic simulation experiments and soldier focused investigations evaluating concepts for multi-modal presentations. Concepts and general human visualization guidelines will transition to Intelligence and Security Command (INSCOM), Army Battle Command System (ABCS), Communications-Electronics RDEC, Battlefield Visualization ATD, Battle Command Battle Lab, and Intelligence Center and Fort Huachuca.
  - Develop refined battle command technology integration requirements for advanced Battle Force unit design (including operations other than war). Begin efforts to translate battle command process models into constructive simulation software.
  -Validate the intelligence production model (IPM) in intelligence field units at varying command levels.

- 5942 - Complete the incorporation of three dimensional laser body scan data into the fully interactive human figure model. Make latest version available to users for application to system design.
  - Provide a unit level modeling capability in IMPRINT for assessment of Force XXI and AAN manning concepts. Develop and validate an approach for predictive modeling of the team behavior component of system performance.
  - Conduct an investigation of the integrated system behavior between the mobility interface device and the control systems for the dismounted soldier combatant simulation. Transition results to STRICOM and the Army Research Institute (ARI).
  - Conduct enhanced HFE field evaluations with soldier in the loop operational test data to upgrade existing capabilities to assess new technologies and systems.
  - Provide HFE support to AMC, AMC RDECs, TRADOC Centers, Schools and Battle Laboratories and other laboratories.

- 1286 - Leverage Strike Force planning and experimentation to address critical training, leader development and soldier support (TLS) research issues in the cognitive engineering of battle command operations. Facilitate transition of research products from the Advanced & Interactive Displays Fed Lab into the experimental process.

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Total 16270